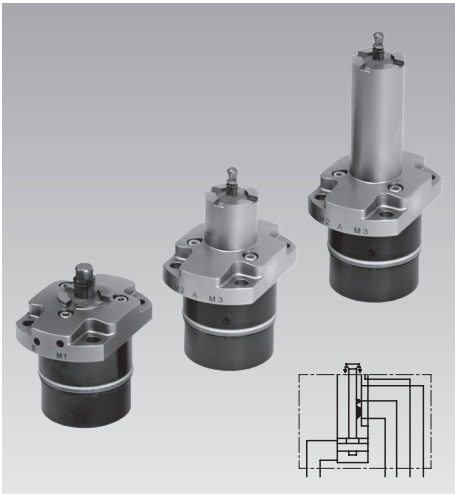




Bore Clamps

**Pneumatic seat check and clamping monitoring, bore Ø 5.5 – 13 mm
double acting, max. operating pressure 30, 80 and 120 bar**



Application

The hydraulically-operated bore clamp is particularly suitable for clamping in workpieces with smooth bore holes in the support surface ranging from 5.5 to 13 mm in diameter.

The workpiece is placed directly onto the hardened supports of the bore clamp and is not deformed during clamping.

Since clamping is effected within the bore, the remaining surfaces are free for machining on 5 sides.

Description

The double-acting hydraulic cylinder operates a conical clamping bolt centrally located in the housing, which expands the hardened clamping bushing. The expansion force causes the points to penetrate into the softer bore surface. This positive connection guarantees a secure clamping of the workpiece (see also "Clamping principle" on page 2).

All functions can be monitored pneumatically.

The use of the connection for positive air pressure protection can prevent liquids and swarf from entering the clamping bushing.

Important notes

The bore clamp has no centring function. To insert and position the workpiece, suitable guides and centring bolts must be provided (see page 2).

The centring bolts also have to absorb the occurring side loads during machining.

A distortion-free workpiece clamping is only guaranteed if the workpiece rests backlash-free on all bore clamps.

The specified clamping forces are only achieved if the points of the clamping bushing can penetrate into the bore wall. (see also "Technical characteristics" max. hardness).

If swarf and liquids penetrate into an open clamping bore, positive air pressure must be continuously switched on.

Axial clamping in smooth bore holes

Machining from 5 sides

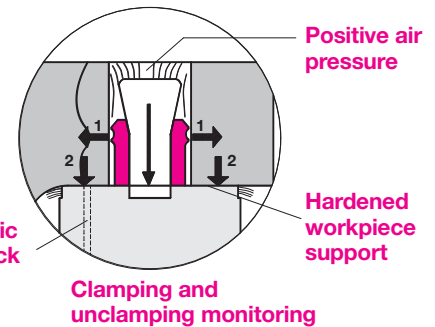
Distortion-free workpiece clamping

Higher precision by tools in standard length

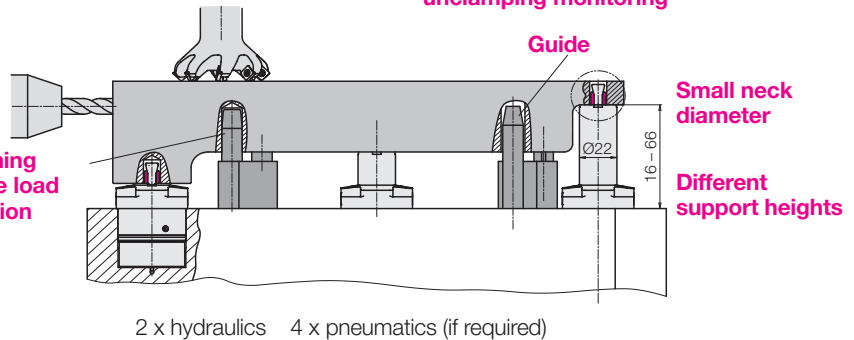
Short tool paths

Reduced processing times

Clamping force up to 5 kN

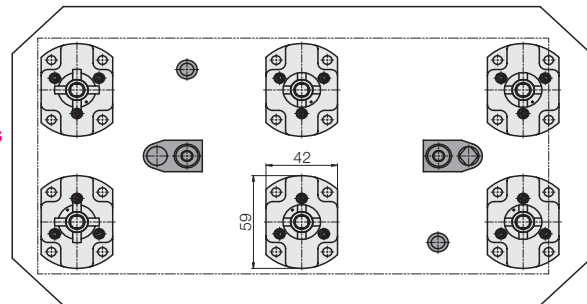


Positioning and side load absorption



Smaller fixtures and machine tables

Efficient swarf management



Function

After pressurising, the conical clamping bolt will be retracted. The clamping bushing will be expanded and the points penetrate into the bore hole wall.

With the penetration of the points increases the hydraulic pressure and thus the clamping force. During unclamping, the clamping bolt extends again. The clamping bushing is relieved and pulled together by a ring spring.

Functional safety

The functional safety is guaranteed if

- the points of the clamping bushing can penetrate into the bore wall (see Technical characteristics workpiece material);
- the diameter of the clamping bore is within the admissible tolerance range of the clamping bushing used;
- the clamping bore in the workpiece is round and perpendicular to the support surface;
- the workpiece rests on the entire surface perpendicular to the bore clamp;
- the support surfaces are free of dirt and swarf;
- the positive air pressure connection is switched on to blow away liquids and chips.

Function control

With bore clamps, visual control of the clamping process is not possible because they are concealed by the workpiece.

For this reason, this bore clamp has three pneumatic and one hydraulic control option as standard:

- Seat check
- Clamping monitoring
- Unclamping monitoring
- Operating pressure control by external pressure switches

We recommend the use of all control options so that information about the current operating status is available at all times.

A detailed description with a function chart and the hydraulic and pneumatic circuit diagram can be found on page 4.

Design with defined return of the clamping segments

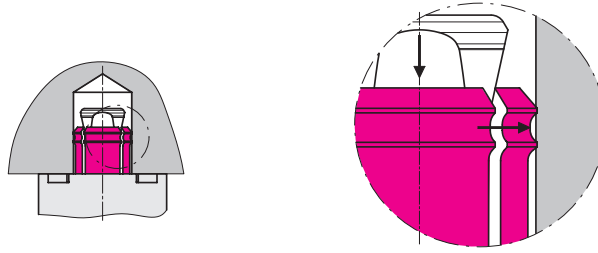
On request

Clamping principle

To ensure that the workpiece is clamped onto the hardened workpiece support with the highest possible force, a positive connection must be established between the clamping bushing and the smooth bore wall.

During the clamping process, the conical clamping bolt spreads the hardened clamping bushing and the circumferential points penetrate into the softer workpiece material.

The penetration depth depends on the hardness of the material. Hardened, highly-tempered but also too soft materials are therefore not suitable (see "Technical characteristics"). In case of doubt, a clamping test should be carried out.

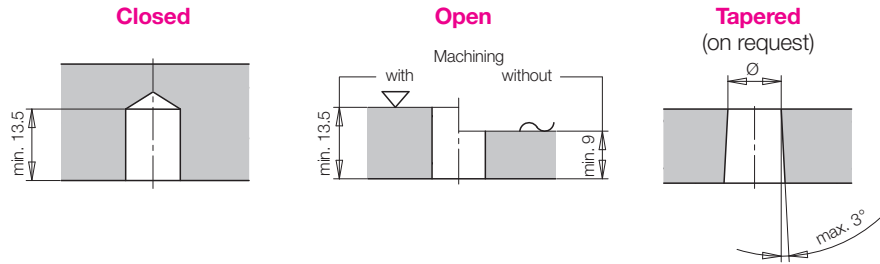


Clamping bore

A closed clamping bore has the advantage that no swarf or liquids can get into the bore clamp through the clamping bushing during machining.

However, the positive air pressure connection can only be switched off if no liquid is present at the workpiece support.

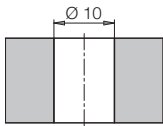
With the open bore, however, the positive air pressure connection must remain permanently switched on.



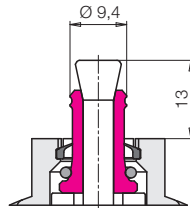
Clamping bushings

Example: Clamping bore $\varnothing 10$ mm

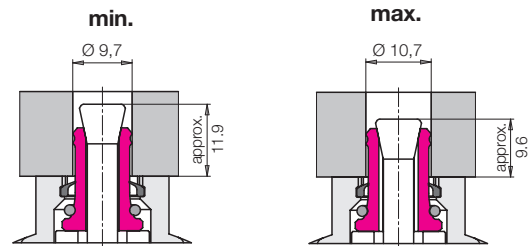
Nominal diameter of the clamping bushing 10



Clamping bushing unclamped



Admissible tolerance of the clamping bore



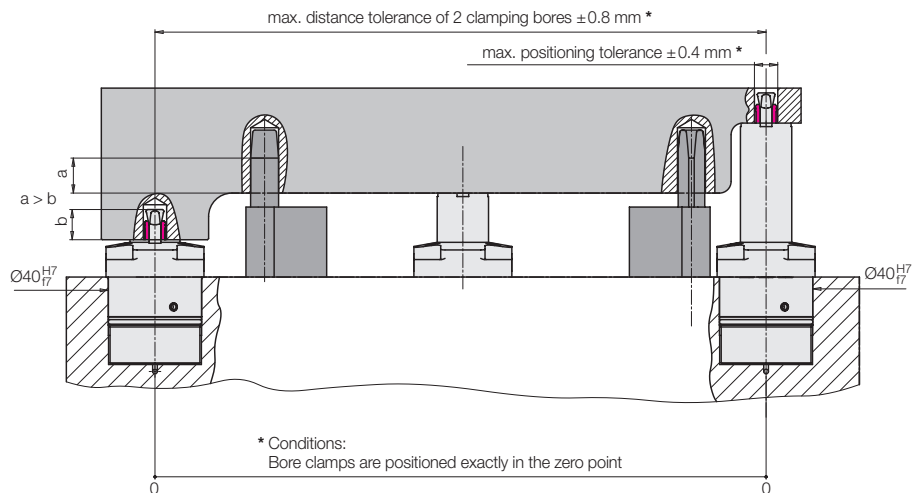
Workpiece loading and positioning

The workpiece is to be guided by insertion pins, especially during automatic loading by robots. The bore clamps have no centring function.

Additional positioning pins (round and flattened) have the following functions

- to bring workpieces into an exact machining position;
- to absorb side loads if these are greater than 10% of the clamping force of the bore clamps.

The functions "Insert" and "Position" can be combined if the centring is long enough (see example $a > b$).



Positioning tolerance

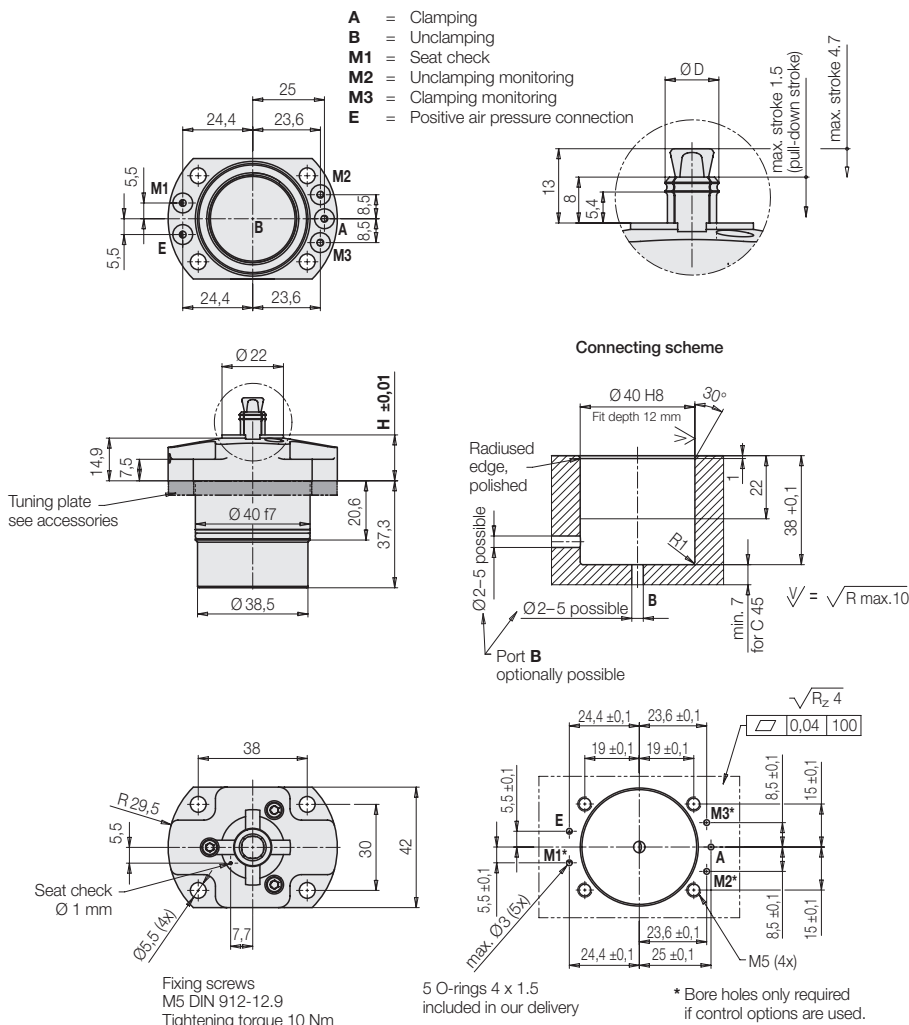
Since the clamping bushing in the housing is radially movable, the workpiece can be positioned with a positioning tolerance of ± 0.4 mm.

Distance tolerance

The distance tolerance of 2 clamping bores can be max. ± 0.8 mm if both bore clamps are positioned at the zero point (nominal dimension).

Dimensions

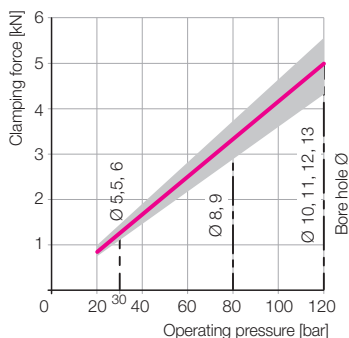
Technical Characteristics • Accessories



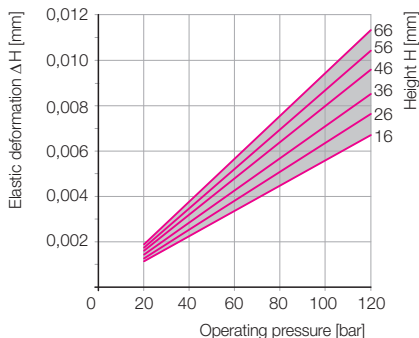
Bore hole Ø D	[mm]	5.5	6	7	8	9	10	11	12	13
Usable clamping range Ø	[mm]	5.2...6.2	5.7...6.7	6.7...7.7	7.7...8.7	8.7...9.7	9.7...10.7	10.7...11.7	11.7...12.7	12.7...13.7
Max. clamping force approx.	[kN]	1.2	1.2	3.3	3.3	3.3	5	5	5	5
Max. radial expansion force approx.	[kN]	3	3	9	9	9	14	14	14	14
Max. operating pressure	[bar]	30	30	80	80	80	120	120	120	120
Min. operating pressure	[bar]					20				
Workpiece material						250/25				
max. hardness HRB/HRC						850				
max. tensile strength	[N/mm²]									
Required positioning tolerance (see page 2)	[mm]					+/- 0.4				
Max. out-of-roundness of the workpiece bore	[mm]					0.1				
Clamping bolt stroke	[mm]					4.7				
Clamping bushing stroke (pull-down clamping)	[mm]					max. 1.5				
Oil volume clamping/unclamping	[cm³]					2.5 / 4				
Adm. flow rate	[cm³/s]					25				
Hydraulic oil as per DIN 51524-2						HLP 32				
Temperature range	[°C]					0...80				
Recommended sensor air pressure	[bar]					2...4				
Recommended pressure for positive air pressure with / without function control	[bar]					max. 1/3				

Clamping force diagram

— = Nominal value
 — = Tolerance range



Elastic deformation ΔH when clamping the workpiece



Part no.

Bore hole Ø	Height H	Weight approx.	Elastic deformation ΔH with load*
[mm] x 10	[mm]	[kg]	[μm / kN]
055	016	0.5	-0.7
060	026	0.53	-0.9
070	036	0.55	-1.1
080	046	0.57	-1.3
090	056	0.6	-1.5
100	066	0.62	-1.7
110			
120			
130			

* Load due to workpiece weight and machining forces

Other sizes on request.

Pneumatic function controls

The bore clamp clamps the workpiece within smooth bores located in the support surface. Visual control of the clamping process is therefore impossible.

Three pneumatic function checks are available for this purpose:

• Seat check M1

Signals the backlash-free contact of the workpiece on the hardened support and is therefore a prerequisite for initiating the clamping process.

• Unclamping monitoring M2

Signals the unclamping position of the clamping bolt and thus the opening of the clamping bushing. Together with pressure switch P2, this is a prerequisite for unhindered loading and unloading of the workpiece.

• Clamping monitoring M3

Signals that the clamping bolt is in the optimum clamping range and that the clamping bushing fits the diameter of the clamping bore.

Together with the seat check M1 and the pressure switch P1, the signal serves for processing release.

Hydraulic function controls

• Clamping pressure P1

Signals that the set operating pressure and the desired clamping force are applied. Together with the seat check M1 and the clamping monitoring M3, the signal serves for processing release.

• Unclamping pressure P2

Signals that the tie rod is held in unclamping position by hydraulic pressure. Together with the unclamping monitoring M2 this is the release for the workpiece change.

Error message in clamping state

(see chart "Example for ...")

Possible sources of error are

- Clamping bore too large
- Clamping bore out of tolerance
- Clamping bore tapered or non-circular
- Workpiece material too hard
- Workpiece material too soft
- Clamping bushing worn or defective
- Clamping bolt defective

Signal conversion Pneumatics → Electrics

If a pneumatic bore is closed, the air pressure in the measuring system increases.

An electro-pneumatic measuring device can either measure the pressure increase or a drop of the air flow rate and convert it into an electrical signal.

Pneumatic pressure switch

Advantage: Easy adjustment

To achieve a sufficient hysteresis of 1–2 bar, the air flow rate must be limited to approx. 12 l/min with a flow control valve. This adjustment is made with an additional flow sensor with digital flow rate display.

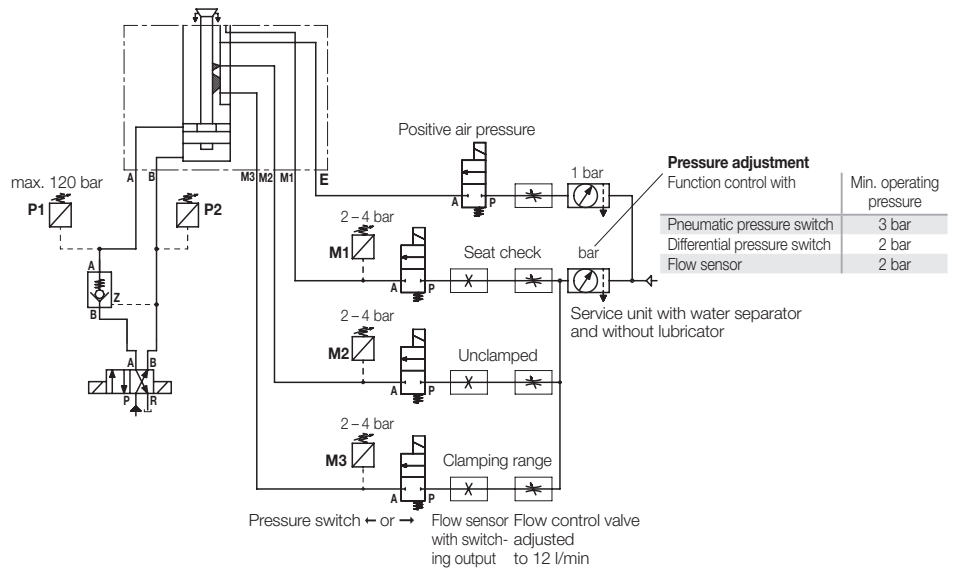
Differential pressure switch

Differential pressure switches (e.g. PEL System) require only 0.5 to 1.5 bar working pressure. The exact adjustment of a setting nozzle under practical conditions is required.

Flow sensor

A function control is also possible independent of pressure by measuring the flow rate. The flow sensor should have a digital display and one adjustable limit switch with a binary output (such as type SFAB of Festo).

Hydraulic and pneumatic circuit diagram with all function checks and positive air pressure connection.



Function chart

Device	Function	Workpiece						
		Loading	Clamping	Clamped	Machining	Unclamping	Unclamped	Unloading
Pneumatics	Nozzle	1	0	0	0	0	0	0
	Pressure switch *	1	1	1	1	1	1	1
	Pressure switch *	1	1	1	1	1	1	1
	Pressure switch *	1	1	1	1	1	1	1
Hydraulics	Bore clamps	A	B	B	B	B	B	B
	Pressure switch	1	0	0	0	0	0	0
	Pressure switch	1	0	0	0	0	0	0
	Pressure switch	1	0	0	0	0	0	0

* alternatively differential pressure switch or flow sensor

Examples for switching positions when using all control elements

Control elements		Status of control elements		
		Bore clamps		
		Unclamped and workpiece does not lie flat on the surface	Clamped Processing release	Error message in clamped state
Seat check	M1	0	1	1
Unclamping monitoring	M2	1	0	0
Clamping monitoring	M3	0	1	0
Clamping pressure	P1	0	1	1
Unclamping pressure	P2	1	0	0

← **Error!**
(see text)

Example

Six seat checks with 2 bar air pressure:

1. Cover all seat checks with one workpiece and measure the flow rate Q_{min} .
 2. If one seat check is not covered, measure Q_{max} .
 3. Enter and save
switching threshold = $0.5 \times (Q_{max} + Q_{min})$.
- If the difference ($Q_{max} - Q_{min}$) is too small, increase the flow rate or reduce the number of bore clamps per sensor.

Number of bore clamps at a function control

For the monitoring of a function, e.g. the seat check, a group of max. 6 bore clamps can be connected to one measuring device. The calibration of the switching pressure requires great care, because the measuring device has to recognize that, for example, only one of the 6 seat checks is not covered. It is not possible to see which one that is!